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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/673,648	09/30/2003	Hideaki Yamasaki	071469-0305916	1164
909	7590	04/18/2005	EXAMINER	
PILLSBURY WINTHROP SHAW PITTMAN, LLP P.O. BOX 10500 MCLEAN, VA 22102			BERRY, RENEE R	
			ART UNIT	PAPER NUMBER

2818

DATE MAILED: 04/18/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/673,648

Applicant(s)

YAMASAKI ET AL.

Examiner

Renee R Berry

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☐ Claim(s) 1-40 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☐ Claim(s) 1-40 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 30 September 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 1/5/05.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: ____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent No. 6,660,330 to Locke et al. in view of US Patent No. 6,827,978 to Yoon et al.

In regards to claim 1, Locke teaches a method of depositing a metal layer on a semiconductor substrate, the method comprising; providing a substrate in a process chamber; introducing a process gas in the process chamber, the process gas comprising a metal-carbonyl precursor gas and at least one of a dilution gas and a carrier gas (column 5, lines 38-44), and depositing a metal layer on the substrate by a thermal chemical vapor deposition process (column 5, lines 7 and 10-12).

In regards to claims 4 and 25, Locke teaches the method according to claim 1, wherein the process gas includes the carrier gas comprising an inert gas (column 5, lines 40-42).

In regards to claims 5 and 26, Locke teaches the method according to claim 4, wherein the inert gas comprises at least one Ar, He, Ne, Kr, Xe, and N₂ (column 5, lines 40-42).

In regards to claims 6 and 27, Locke teaches the method according to claim 1, wherein the process gas includes the carrier gas comprising a reducing gas (column 5, lines 37-41).

In regards to claims 8 and 29, Locke teaches the method according to claim 1, wherein the process gas includes the dilution gas comprising an inert gas at column 5, lines 41-42.

In regards to claims 9 and 30, Locke teaches the method according to claim 8, wherein the inert gas comprises at least one Ar, He, Ne, Kr, Xe, and N₂ (column 5, lines 41-43).

In regard to claim 10, Locke teaches the method according to claim 1, wherein the process gas includes the dilution gas comprising a reducing gas at column 5, lines 37-40.

In regards to claims 12 and 33, Locke teaches the method according to claim 1, wherein the metal-carbonyl gas flow rate is between about 0.1 sccm to about 200 sccm (column 5, lines 60-61).

In regards to claims 13 and 34, Locke teaches the method according to claim 4, wherein the carrier gas flow rate is less than about 1000 sccm (column 5, lines 60-61).

In regards to claim 14, Locke teaches the method according to claim 1, wherein the process gas includes the dilution gas having a flow rate less than about 2000 sccm at column 5, lines 60-61.

In regards to claim 15, Locke teaches the method according to claim 1, wherein the process gas flow rate is greater than about 400 sccm at column 5, lines 60-61.

In regards to claims 16 and 36, Locke teaches the method according to claim 1, wherein the chamber pressure is less than about 200 mTorr at column 5, lines 10-13.

In regards to claims 17 and 37, Locke teaches the method according to claim 1, wherein the chamber pressure is less than about 100 mTorr at column 5, lines 10-13.

In regards to claims 18 and 38, Locke teaches the method according to claim 1, wherein the substrate temperature is less than about 500⁰ C at column 5, line 62.

In regards to claim 19, Locke teaches the method according to claim 1, wherein the substrate temperature is less than about 400⁰ C at column 5, line 62.

In regards to claim 20, Locke teaches the method according to claim 1, wherein the metal-carbonyl precursor comprises at least one of W(CO)₆, Ni(CO)₄, Mo(CO)₆, Co₂(CO)₈, Rh₄(CO)₁₂, Re₂(CO)₁₂, Cr(CO)₆, and Ru₃(CO)₁₂ (column 5, lines 35-37).

In regards to claim 21, Locke teaches the method according to claim 1, wherein the metal layer comprises at least one of W, Ni, Mo, Co, Rh, Re, Cr, and Ru at column 8, line 57.

In regards to claim 22, Locke teaches a method of depositing a W layer, the method comprising: providing a substrate in a process chamber; flowing a process gas in the process chamber, the process gas comprising a W(CO)₆ precursor gas and at least one of a dilution gas and a carrier gas (column 5, lines 38-44), and depositing a W

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layer on the substrate by a thermal chemical vapor deposition process (column 5, lines 7 and 10-12).

In regards to claim 39, Locke teaches the method according to claim 22, wherein the substrate temperature is less than about 450°C at column 5, line 63.

In regards to claim 40, Locke teaches the method according to claim 22, wherein the substrate temperature is about 410°C at column 5, line 63.

However, Locke does not teach all the limitations of the claims as follows:

In regards to claims 1 and 20, Yoon teaches wherein the ratio of the $\text{W}(\text{CO})_6$ precursor gas flow rate and the process gas flow rate is less than about 0.15 at column 10, lines 55-58 (WF_6 at 50 sccm and carrier gas at 550 sccm or 0.1).

In regards to claim 2, Yoon teaches the method according to claim 1, wherein the ratio of the metal-carbonyl precursor gas flow rate and the process gas flow rate is about 0.10 at column 10, lines 55-58 (WF_6 at 50 sccm and carrier gas at 550 sccm or ~ 0.1).

In regards to claim 3, Yoon teaches the method according to claim 1, wherein the ratio of the metal- carbonyl precursor gas flow rate and the process gas flow rate is less than about 0.0625 at column 9, lines 60-63 (WF_6 at 10 sccm and carrier gas at 1,000 sccm or ~ 0.001).

In regards to claims 7 and 28, Yoon teaches the method according to claim 6, wherein the reducing gas comprises H_2 at column 8, lines 34-39.

In regards to claim 11, Yoon teaches the method according to claim 10, wherein the reducing gas comprises H_2 at column 8, lines 34-39.

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified Locke to include the ratio of the $W(\text{CO})_6$ precursor gas flow rate and the process gas flow rate is less than about 0.15 or 0.10 or 0.0625; and the reducing gas comprises H_2 , since such a modification would result in enhanced morphology as described in column 1, lines 25-31 of Yoon et al.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. US Patent No. 4,741,928 to Wilson et al. discloses the use of tungsten hexafluoride and their flow rates.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Renee R Berry whose telephone number is (571) 272-1774. The examiner can normally be reached on M-F 9-5:30.


The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


RRB

February 4, 2005


David Nelms
Supervisory Patent Examiner
Technology Center 2800